# Water Wonders: Exploring Water’s Unique Properties

Properties demonstrated with this activity…

- Capillary Action
- Universal Solvent
- Surface Tension

**Capillary Action:**

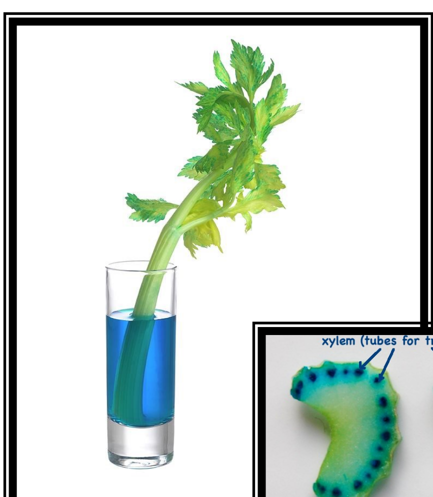
Using its attraction to other water molecules (cohesion) and its attraction for other substances (adhesion), water will defy gravity and be draw up into plants to feed the cells. This is true even in humans. It enables blood to be drawn for testing through a small needle and tiny tubes making the sampling of blood a very non-invasive procedure.

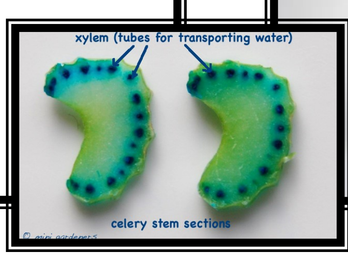
For this activity you will need…

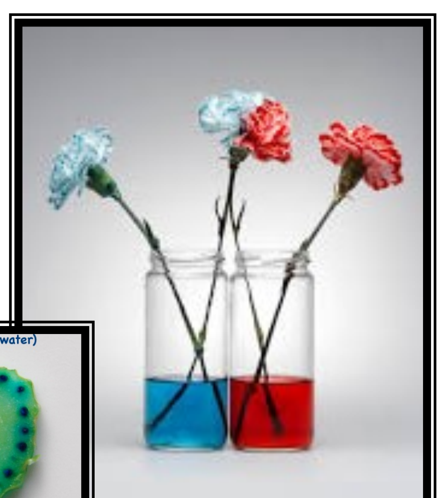
- A stalk of celery (with leaves if possible)
- A fresh flower with its stem (carnations would do very well)
- One 1” x 2” strip of paper towel
- A tall water glass, water, and food coloring

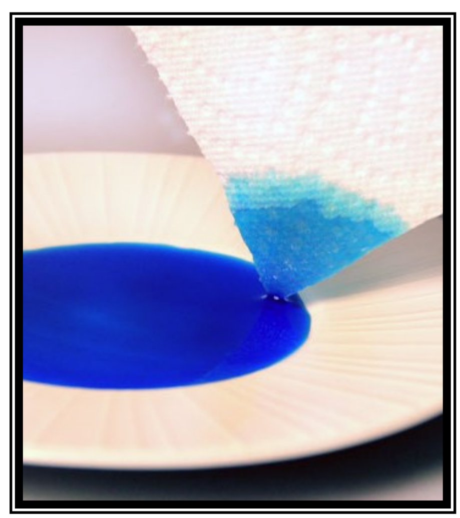
Fill the water glass about half way with water and add the food coloring. Red or blue work very well. Cut the bottom end of the celery stalk and the flower stem. This will freshly open the stems to accept the coloring water. Place the freshly cut stems into the colored water, set the glass in a window, and wait. Over the next 24 hours, capillary action will cause the colored water to rise in the stems, enter the plant cells. What changes can you observe? What tells you that the colored water rose in the stems? Cut the stems and observes the cells. What do they look like?

To watch this capillary action in ‘real’ time, take the strip of paper towel and place one end in the colored water. What happens? This is capillary action and what is taking place inside the celery and flower stems bringing water and food to the plant cells.







## Water Wonders Continued…

### Universal Solvent:

Water is called the "universal solvent" because it is capable of dissolving more substances than any other liquid. This is important to every living thing on earth. It means that wherever water goes, either through the air, the ground, or through our bodies, it takes along valuable chemicals, minerals, and nutrients.

It is water's chemical composition and physical attributes that make it such an excellent solvent. Water molecules have a polar arrangement of oxygen and hydrogen atoms—one side (hydrogen) has a positive electrical charge and the other side (oxygen) had a negative charge. A substance that can be dissolved in water has a composition that is attracted to the negative/positive pull of the water. This substance is called a 'solute' of water. Though water can dissolve many substances, there are substances that it cannot  dissolve in water (insoluble).

Let's try an experiment. You will need…

- (4) water glasses filled about half way with water
- (1) Tablespoon each salt, sugar, sand, and vegetable oil and (4) spoons
- Liquid dish soap and glitter

One at a time, place the tablespoon of each substance in its own glass of water and stir about 1 minute. What happens in each glass? Do any of the substances appear to disappear (dissolve)? Do any remain visible (insoluble)? Which ones?

### Why soap 'makes water, wetter'

Water is a polar solvent and, as has been discussed will mix with, and dissolve, other polar molecules and ionic salts, but will not dissolve non-polar molecules.  Hence water is not very good at cleaning greasy plates and clothes by itself. What is required is a way of bridging the gap between the non-polar oil and proteins (which holds the dirt to the fabric / dishes) and the polar water molecules?

Soap and detergents are quite unique molecules with the ability to dissolve in both polar and non -polar solvents. Both soap and detergents are composed of long non-polar hydrocarbon molecules with a polar or ionic end, thus they combine both polar and non-polar characteristics in the same molecule. This allows the soap and detergent molecules to bond with both oil and water molecules at the same time, forming a connection between the oil and the surrounding water molecules. Soap and detergents operate at the interface between the oil and the water and are known as "surface active substances".

To show this, let's try another experiment using the water glass with oil in it, the dish soap, and the glitter.

Sprinkle the glitter on the floating oil. The oil keeps the glitter floating. Now take and place a drop of liquid dish soap in the middle of the floating glitter. What happened? Now stir the soap, water, glitter, and oil together. What happens to each substance? This is why soap is always a good idea when washing our hands, dishes, and laundry.

## Water Wonders Continued…

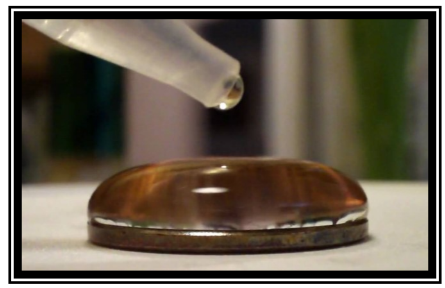
### Surface Tension:

Water's polarity makes water molecules attracted to other water molecules in a bond (cohesion**).** This bonding creates a molecular film at the surface of any pooling of water. The surface can hold up a weight, and the surface of a water droplet holds the droplet together, in a ball shape. Some small things can float on a surface because of surface tension, even though they normally could not float. Some insects (e.g. water striders) can run on the surface of water because of this. This characteristic makes many of water's properties possible.

Let's explore this with some visual experiments. You will need…

- An eye dropper
- Coins (10 or 20 pennies and a nickel) and/or wax paper
- A small mouthed glass or container filled to the top edge with water
- A large wide-mouthed glass or container filled nearly to the top edge with water and a fork
- A variety of items that may sink or float on water (paper clips, pebbles, packing peanuts, small piece of wood leaves etc.)

### Water forms drops activity…



Using the eye dropper, water, and the coins or the paper, place droplets of water on the surface of the item, one drop at a time. What happens? What shape does the droplet take? Now continue to add droplets one at a time, counting each drop. How many droplets can the item hold before the water breaks the tension and spills out over or off the item? The shape is caused by surface tension and eventually the force of gravity is too great and the shape is broken.

During this activity, was there a difference in the number of droplets that remained on the larger and smaller coins? Was the number of droplets greater on the paper where there were no edges? Can you explain the differences?

Now take the small mouthed glass filled to the top edge with water. Let's carefully add pennies, one at a time. Observe the top edge of the glass. What is happening? How many pennies do you place in the glass before the water surface tension is broken? (It may be easier to see what is happening by positioning your head to the side of the glass to observe the water as it meets the top edge of the glass.) *It should be noted that the laws of physics say that "two objects cannot occupy the same space at the same time". Therefore, adding pennies to the water will make the water rise to make room for the penny.*

### Sink or Float…

Take the large mouthed glass and try several of your selected items to see which ones 'sink or float'. Which ones sink and which ones float? Can you explain why some items floated and others did not? Consider: weight, shape the make-up of the substance. Remove the items from the water.

Now let's see if we can make some of these items float using the surface tension of the water. Hint: Use the fork to slowly lower the items into the water . Too much disturbance of the surface can break the tension so it requires a delicate touch.

Which items can you get to float that didn't float before? Can you see where they are being held up by the water? Look at the picture here of a paper clip floating on the water. What do you see? Does the clip appear to be making a indentation in the water. This is 'surface tension'! Where else have you seen this in nature? Take a walk and see if you can find examples.